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## TITLE

# PDA WITH BUILT-IN VOLTAGE PROTECTION

## BACKGROUND OF THE INVENTION

### Field of the Invention

The present invention relates to a voltage protection device. In particular, the present invention relates to a voltage protection device built into a PDA (personal digital assistant) device to limit voltage input.

### Description of the Related Art

In recent years, hand-held electronic devices have become increasingly popular. Typically, various hand-held electronic devices are powered by their respective adapters.

If a PDA is subjected to excessive voltage, the PDA can be damaged. Additionally, with prolonged use, an adapter may provide excessive or inadequate voltage potentially damaging the PDA.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide voltage control. The voltage protection device limits an input voltage within a preset range.

It is another object of the present invention to provide a PDA with a built-in voltage protection device.

To achieve the above-mentioned object of the invention provide a voltage protection device is provided. The voltage protection device comprises, a

first limiting device, a first switch device, a second limiting device and a second switch device. The first limiting device compares an input voltage with preset maximum voltage, wherein the first limiting device outputs a first enable signal when the input voltage is less than the preset maximum voltage. The first switch device has a first input terminal coupled to the input voltage, a first control terminal, and a first output terminal, wherein the first switch device outputs the input voltage when the first control terminal receives the first enable signal. The second limiting device is coupled to the first output terminal to compare the input voltage from the first switch device with a preset minimum voltage, to output a second enable signal when the input voltage is greater than the preset minimum voltage. The second switch device has a second input terminal coupled to the first output terminal, a second control terminal, and a second output terminal, wherein the second switch device outputs the input voltage when the second control terminal receives the second enable signal.

Another object of the present invention is to provide a PDA. The PDA includes a main device, a socket, and a voltage protection module. The main device performs necessary data processing. The socket connects to an adapter. The voltage protection module is coupled between the main device and the socket, for receiving an input voltage from the adapter and allowing the input voltage to be applied to the main device when the input

voltage is between a preset maximum voltage and a preset minimum voltage.

## BRIEF DESCRIPTION OF THE DRAWINGS

The present invention can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

Fig. 1 shows a PDA with built-in voltage protection;

Fig. 2 shows the block diagram according to a preferred embodiment of the present invention;

Fig. 3 is the first control module 20 internal circuit block diagram;

Fig. 4 is the second control module 21 internal circuit block diagram.

## DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 shows a PDA with built-in voltage protection. An adapter 14 is connected to a PDA 10. The PDA 10 comprises a socket 11, a voltage protection module 12 and a main device 13. The main device 13 performs necessary data processing. The socket 11 connects to the adapter 14. The voltage protection module 12 receives an adapter voltage $V_{ADA}$ from the adapter 14. The voltage protection module 12 outputs a PDA voltage $V_{PDA}$ to the main device 13 when the input voltage $V_{ADA}$ is between a preset maximum voltage and a preset minimum voltage.

Fig. 2 shows the block diagram of the present invention. The voltage protection module 12 includes a first control module 20 and a second control module 21.

The first control module 20 has a first input terminal and a first output terminal, the first input terminal is coupled to the socket 11 to receive the adapter voltage $V_{ADA}$ from the adapter 14, the first output terminal outputs the first voltage $V_{ADA1}$ when the adapter voltage $V_{ADA}$ is less than the preset maximum.

The second control module 21 has a second input terminal and a second output terminal. The second input terminal receives the first voltage $V_{ADA1}$ from the first output terminal. The second output terminal outputs the PDA voltage $V_{PDA}$ to the main device 13 when the first voltage $V_{ADA1}$ is greater than the preset minimum.

The first control module 20 comprises a first limiting device 201 and a first switch device 202. The first limiting device 201 receives the adapter voltage $V_{ADA}$. The first limiting device 201 outputs a first enable signal $S_{EN1}$ when the adapter voltage $V_{ADA}$ is less than the preset maximum. The first switch device 202 receives the adapter voltage $V_{ADA}$. Upon receiving the first enable signal $S_{EN1}$, the first switch device 202 outputs the received adapter voltage $V_{ADA}$ as a first voltage $V_{ADA1}$. Therefore, the first voltage $V_{ADA1}$ is equal to the adapter voltage $V_{ADA}$.

The second control module 21 comprises a second limiting device 211 and a second switch device 212. The second limiting device 211 receives the first voltage $V_{ADA1}$ from the first control module 20. When the first voltage $V_{ADA1}$ is greater than the preset minimum, the second limiting device 211 outputs a second enable signal $S_{EN2}$.

Figs. 3 and 4 show the circuit of the present invention. Fig. 3 is a circuit of the first control module 20. The capacitors C1~C4 cancel noise from the adapter voltage $V_{ADA}$. The diodes D1 and D2 provide a current limiting function. The resistors R1 and R2 serve as a voltage divider. A voltage limiting IC MAX1807 determines whether or not the adapter voltage $V_{ADA}$ is less than the preset maximum.

If the adapter voltage $V_{ADA}$ is less than the preset maximum, the voltage limiting IC MAX1807 outputs the first enable signal $S_{EN1}$. A switch device U1 outputs the first voltage $V_{ADA1}$ when the switch device U1 receives the first enable signal $S_{EN1}$. The first voltage $V_{ADA1}$ is the same as the adapter voltage $V_{ADA}$.

Fig. 4 is a circuit of the second control module 21. The voltage limiting IC MAX821 determines whether or not the first voltage $V_{ADA1}$ is greater than the preset minimum.

The limit voltage IC MAX821 outputs a second enable signal $S_{EN2}$ to a transistor Q1A when the first voltage $V_{ADA1}$ is greater than the preset minimum. A switch device U3 outputs the PDA voltage $V_{PDA}$ to the main device 13 when the switch device U3 receives the second enable signal $S_{EN2}$. The PDA voltage $V_{PDA}$ is equal to the first voltage $V_{ADA1}$.

Accordingly, advantages of the present invention are described in the following.

The present invention detects the range of the input voltage (adapter voltage $V_{ADA}$) to prevent a higher voltage from being input to the PDA. Additionally the PDA of the present invention, user is able to accept any adapter.

If the adapter supplies an out of range voltage, the voltage protection device cuts off power from the adapter. Finally, when the adapter is used too frequently, the present invention separates the error voltage according to different voltage specifications.

While the invention has been described by way of example and in terms of the preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments. To the contrary, it is intended to cover various modifications and similar arrangements (as would be apparent to those skilled in the art). Therefore, the scope of the appended claims should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.